REMARKS/ARGUMENTS

Reference is made to the December 21, 2005 telephone conference with Examiner Yee. During the conference, Applicant and his attorney pointed out the major differences between Applicants' invention and the cited references.

This invention is the result of a funded three year US Department of Defense project to find an alternative to the expensive high strength, high toughness alloy steels, commonly referred to as "super alloys", which the government purchases for armor, aircraft landing gear and in other demanding applications. The superior properties of these steels require high concentrations of expensive alloying materials, such as cobalt, molybdenum and nickel. By way of examples, the super alloy AF14-10 steel which the government uses has 14% cobalt, 10% nickel and 1% molybdenum. The HP-9-4-30 alloy steel has 4% cobalt and 8% nickel. The Vascomax T-250 steel has 18.5% nickel. The invention has similar properties without high concentrations of these alloying materials.

Applicants' compositions differ from the applied references in several important ways. First, neither of the references is a high strength, high toughness steel. Philip claims to be a high toughness, high strength steel but is not the high strength, high toughness steel of the super alloys. Philips is capable of providing high strength but does not meet the government's criteria for high toughness. Dubois is a high toughness steel but is not a high strength steel.

Second, Applicants' Si/Cu ratio of 1.2 to 2.5 is a key parameter which distinguishes the claimed compositions from Philips. In Phillip the magnitude of the Si/Cu ratio is about

the same but is reversed. The importance of the Si to Cu ratio is discussed on line 17 of page 3 and on lines 1 through 11, page 4.

Third, Applicants' carbon range of 0.22 to 0.55% exceeds the carbon range of Dubois.

Fourth, Applicant's compositions neither require cobalt nor molybdenum.

Heretofore it has not been possible to combine high strength and high toughness in an alloy steel without high concentrations of expensive alloying elements. Achieving a combination of high toughness and high strength in metal alloys without expensive elements and processes has always been the goal of metallurgical research.

The Examiner objected to the negative limitations claim 1-3 and 9-11, "eliminating the use of scarce high cost elements cobalt and molybdenum" under 35 USC 112 as "new matter." The Examiner's attention is directed to page 2, lines 8 through 15 in the specification"

> "The present invention is a relatively low cost high strength high toughness medium Carbon Copper-Nickel-Chromium alloy steel. A primary object of the invention is to provide a lower cost alternative to current high cost Group A Alloy Steels. . . . A still further object, in addition to the foregoing objects, is to reduce the use of scarce alloying elements such as Cobalt."

It should be noted that Cobalt was cited as an example of high cost alloying elements rather than in a limiting sense. For this reason, Applicant disagrees with the Examiner 35 USC 112 rejection in paragraph 3 of page 2 of the advisory action and believes that the negative limitation patentably distinguishes claims 1-3 and 9-11 from the Dubois and Phillip references. The negative limitation is further supported by the high strength/high toughness properties of the alloys in Table 1 which do not include cobalt and molybdenum.

Answering paragraph 4 on page 2, the Examiner objected to the "less than 0.65% copper" in claim 8 on the grounds it was not supported by the specification. Claim 8 has been cancelled. However, the Examiner's attention is directed to Table 1 wherein 18 out 20 of Applicants' alloys have less than 0.65% copper. This limitation was included to distinguish claim 8 from Phillip which requires 0.65% to 4.0% copper and is consistent with Applicant's disclosure.

Answering paragraph 7, claims 1-3, 5, 9 and 10 have been re-drawn in Markush form in accordance with Examiner's recommendation.

Answering paragraph 9, claims 1 through 14 are not obvious over Dubois or Phillip or ASM Table 1, 1 for the following reasons. Dubois is a carburizing steel having up to .18% carbon. Carburizing, a thermo-chemical process, increases the hardness of a thin outer layer of a component. The Examiner has not shown any actual case, nor are Applicants aware of any actual case, wherein carburizing has been used to increase the amount of carbon in an entire part. Nor do applicants believe that for other than extremely thin sections, carburizing can be used to increase carbon as the Examiner contends.

Due to the nature of the carburizing process the level of carbon in the present invention (0.22-0.55%) can be achieved only in a thin portion of diffusion layer of a carburized part. At the same time, concentrations of Si, Cu and Ni, the non carbide forming elements, in the diffusion layer after carburizing would be affected and would differ from the initial composition in the core and from the composition of the present invention. Adding carbon to Dubois will increase strength, as the examiner comments

(and per ASM Table 1.1), but will not achieve the combination of ductility, toughness and high strength of the present invention.

Claim 5 is patentably distinguishable from Dubois by the positive limitations of a carbon composition of about 0.35-0.50%, from Phillip by the negative limitation of "eliminating the use of the scarce high cost alloying elements cobalt and molybdenum", and a minimum impact strength KCV of at least 28 ft-lbs. Claims 2 and 11 are distinguishable from the references by a silicon to copper ratio of 1.2 to 2.5. Claims 1, 2, 3, 9, 10, and 11 through 14 are distinguishable from the references by the negative limitation of "eliminating the use of the scarce high cost alloying elements cobalt and molybdenum." Since claims 4, 6 and 7, 12 through 14 depend from the above claims they are distinguishable for the same reasons.[1]

A comparison of the examples in Philip with the examples in Applicants' Table 1 show that as carbon is increased in Philip from about 0.12% to 0.4%, ductility and toughness fall sharply below those of the present invention. The reason for this is that Si to Cu ratio in Philip is the reverse of the Si to Cu ratio in Applicants' compositions, hence in the example given by Philip the ductility, toughness and ratio of yield strength to ultimate strength are significantly lower than in Applicants' composition.

Although Applicants believe that the claims as previously amended are patentably distinguishable from the applied references, to advance this case to allowance, Applicants have cancelled claims 4, 6, 7, 8, 11-14.

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[1] Please note that the element nickel was removed from this limitation in Applicants' previously filed Supplemental Amendment.

Although Applicants' believe that the claims as now amended are patentably distinguishable from the references, Applicants' have attached a proposed set of amended claims to further distinguish the claims from the references. Approval of these claims is requested.

It is believed that the proposed changes to the claims merely further limit the claims will not require any further searching by the Examiner. Favorable action by the Examiner on the proposed claims is respectfully requested.

Respectfully submitted,

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Dated: December 26, 2005

PROPOSED CLAIMS

1. (currently amended) A deep hardening Cu/Ni/Cr alloy steel for reducing the cost of high toughness, high strength steels, by eliminating the use of the scarce high cost alloying elements cobalt and molybdenum comprising by weight: about 0.22-0.55% carbon, about 0.40-1.0% copper; about 0.80-3.5% of chromium; about 2.5-8.0% nickel; about 0.55-1.50% of silicon, said silicon and said copper being present in a Si to Cu weight ratio of about 1.2-2.5 ; about 0.15-1.50% manganese; at least one ~~of the~~ transitional ~~elements~~, element from the group consisting of vanadium in about 0.10-1.00% by weight and titanium in about 0.10-0.65% by weight; and the remainder iron~~,~~ ~~carbon~~ and incidental impurities.

2. (currently amended) A deep hardening Cu/Ni/Cr alloy steel for reducing the cost of high toughness, high strength steels by eliminating the use of the scarce high cost alloying elements cobalt and molybdenum comprising about 0.40-0.65% by weight of copper; about 0.75-1.50% by weight of silicon, said copper and said silicon being present in a Si to Cu weight ratio of about 1.2-2.5 ~~%~~; about 1.50-3.50% by weight of chromium; about 1.0-6.0% by weight of nickel; about 0.35-0.50% by weight of carbon before and after deep hardening; about 0.50-1.50% by weight of manganese; at least one ~~of the~~ transitional ~~elements~~; element from the group consisting of vanadium in about 0.10-1.00% by weight and titanium in about 0.10-0.65% by weight; and the remainder iron and incidental impurities.

3. (currently amended) A deep hardening Cu/Ni/Cr alloy steel for reducing the cost of high toughness high strength steels by eliminating the use of the scarce high cost alloying elements cobalt and molybdenum comprising by weight about 0.22 to 0.55% C, about 0.4 to 1.0% Cu, about 2.5 to 8.0% of Ni, about 0.8 to 3.5% Cr, about 0.50 to 1.5% Si, said copper and said silicon being present in a Si to Cu weight ratio of about 1.2-2.5; about 0.50 to 1.50% Mn; at least one ~~of the~~ transitional ~~elements~~, element from the group consisting of vanadium in about 0.10-1.00% by weight and titanium in about 0.10-0.65% by weight and characterized by the presence of retained austenite after quenching form an austenitizing temperature, said steel having a microstructure comprised of a major phase of lath martensite enveloped by a minor phase of retained austenite.

4. (cancelled)

5. (currently amended) A low cost rolled or forged article of high toughness, high strength Cu/Ni/Cr alloy deep hardening steel having after quenching and tempering an HRC hardness of at least 50, a yield strength of at least 200 ksi and an impact strength value ~~KcV~~ KCV of at least 28 ft-lb, and consisting essentially of by weight: about 0.50-0.70% of copper; about 0.80-3.50% of chromium; about 2.0-8.0% nickel; about 0.35-0.50% carbon; about 0.75-1.50% silicon, said copper and said silicon being present in a Si to Cu weight ratio of about 1.2-2.5; about 0.65-1.20% manganese; at least one transitional element from the group consisting of vanadium in about 0.10-1.00% by

weight and titanium in about 0.10-0.65% by weight; and the remainder iron and incidental impurities.

6. (cancelled)

7. (cancelled)

8. (cancelled)

9. (currently amended) An article manufactured from a low cost, high toughness, high strength Cu/Ni/Cr alloy steel without the scarce high cost alloying elements cobalt and molybdenum consisting by weight essentially of: about 0.32-0.55% carbon, about 0.50-1.00% of silicon; about 0.40-1.0% copper, said copper and said silicon being present in a silicon to copper weight ration of about 1.2-2.5; about 0.80-3.5% of chromium; about 1.0-3.5% nickel; about 0.50-1.00% manganese; at least one transitional element from the group of elements: 0.10-1.0% of vanadium, 0.10-0.65% titanium; and the remainder iron and incidental impurities and having after nitriding an exceptionally deep and hard outer case and high core strength and toughness.

10. (currently amended) A rolled or forged article made from a low cost high toughness, high strength, Cu/Ni/Cr deep hardening alloy steel without the scarce high cost alloying elements cobalt and molybdenum consisting essentially by weight of about 0.35 to 0.50% carbon; about 0.4 to 1.0% Cu, about 2.0 to 8.0% of Ni, about 0.8 to 3.5%

Cr, about 0.50 to 1.5% Si, said copper and said silicon being present in a Si to Cu weight ratio of about 1.2-2.5; at least one transitional element from a group ~~of transitional elements:~~ consisting of vanadium in about 0.10-1.0% ~~of vanadium,~~ by weight and titanium in about 0.10-0.65% by weight ~~titanium~~, the remainder iron and incidental impurities and characterized by the presence of retained austenite after quenching from an austenitizing temperature, said steel having a microstructure comprised of a major phase of lath martensite enveloped by a minor phase of retained austenite and a hardness of at least HRC 50, a yield strength of at least about 200 ksi and a Charpy impact value KCV of about at least 28 ft-lb.

11. (cancelled)

12. (cancelled)

13. (cancelled)

14. (cancelled)

REMARKS

Reconsideration of the subject application is requested. Applicant believes that this application should be allowed because of the following reasons.

Cr, about 0.50 to 1.5% Si, said copper and said silicon being present in a Si to Cu weight ratio of about 1.2-2.5; at least one transitional element from a group ~~of transitional elements:~~ consisting of vanadium in about 0.10-1.0% ~~of vanadium,~~ by weight and titanium in about 0.10-0.65% by weight ~~titanium~~, the remainder iron and incidental impurities and characterized by the presence of retained austenite after quenching from an austenitizing temperature, said steel having a microstructure comprised of a major phase of lath martensite enveloped by a minor phase of retained austenite and a hardness of at least HRC 50, a yield strength of at least about 200 ksi and a Charpy impact value KCV of about at least 28 ft-lb.

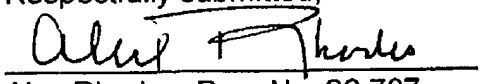
11. (cancelled)

12. (cancelled)

13. (cancelled)

14. (cancelled)

Respectfully submitted,



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